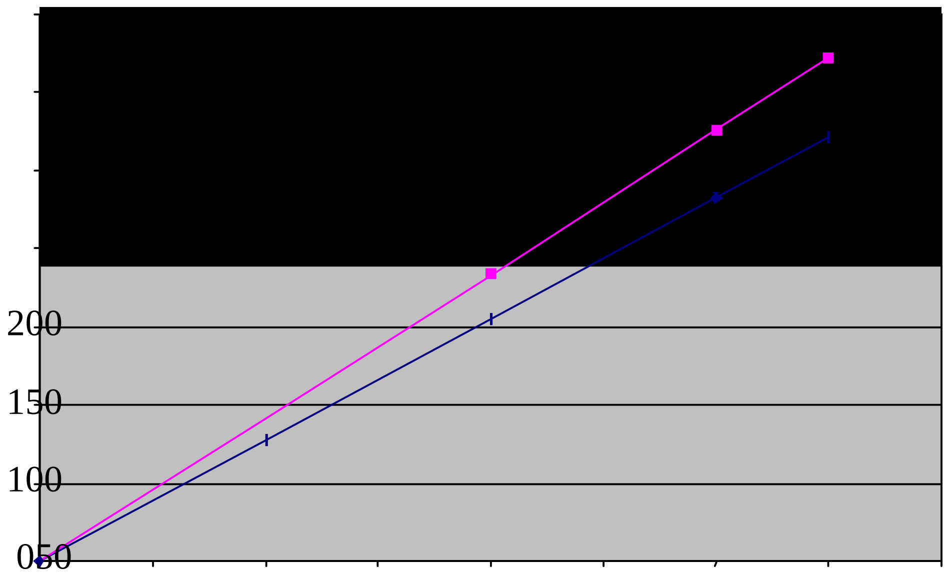
Evaporative Cooling Calculations

Topics

Assumptions:

Using an outlet quality of 0.9 and the heat capacity of the coolant vapor at constant pressure (
Cp) the power required to increase the temperature of the coolant exhaust

Power Required to RaQse Exhaust temperature from -20C to +25C versus Coolant Flow

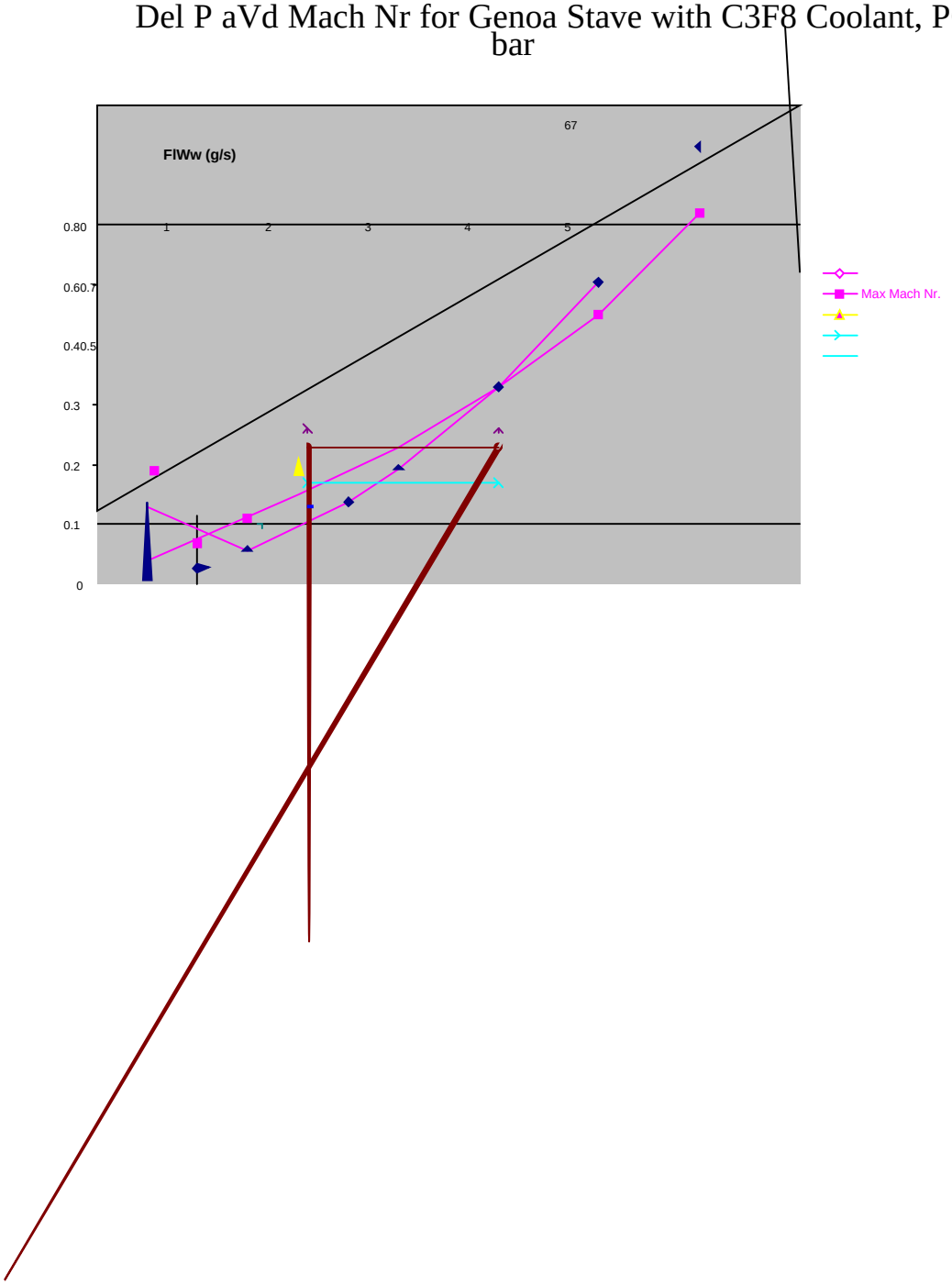


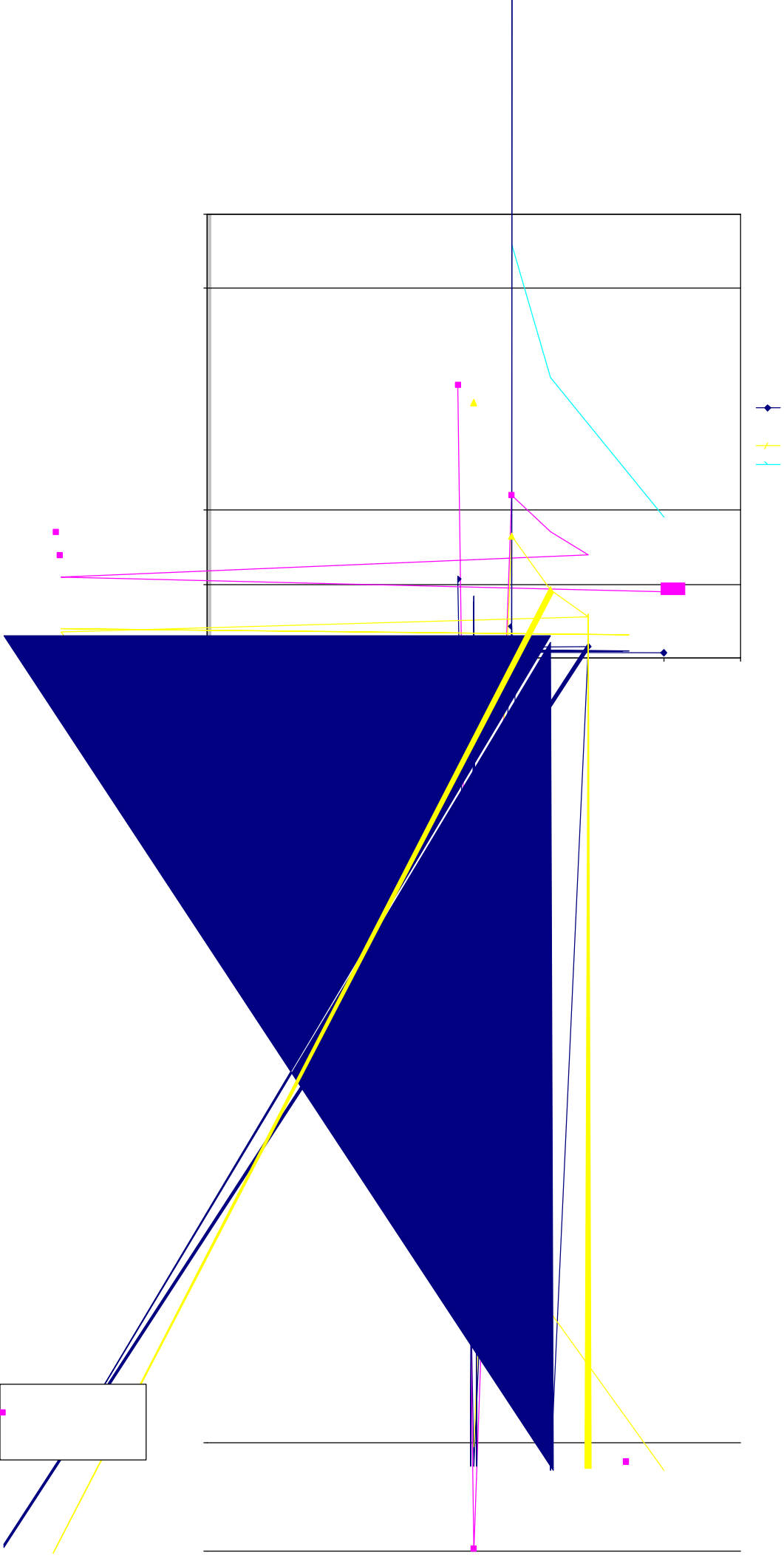
Based on following:The evaporating Tiquid coolant in a stave or sector occupies approximately5

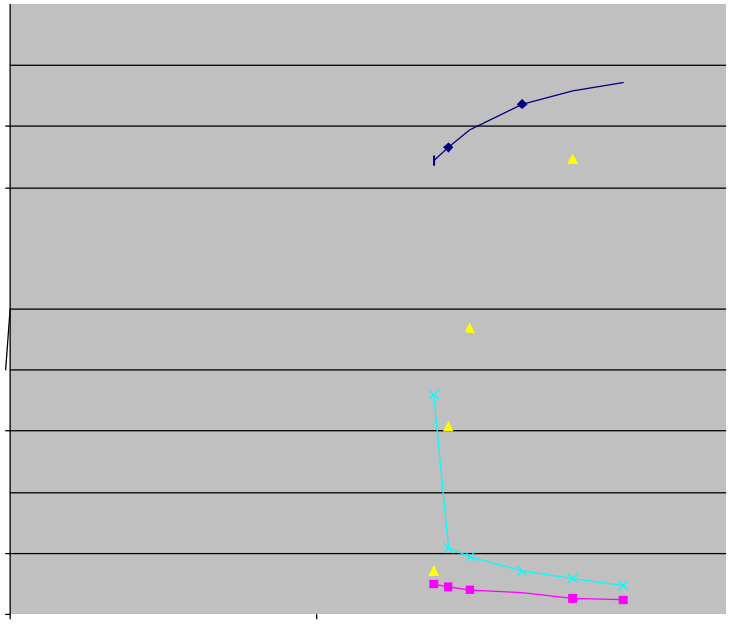
Assume the pressure drop Qs entirely due to vapor flow at isothermalconditionsAssume the Tiqu

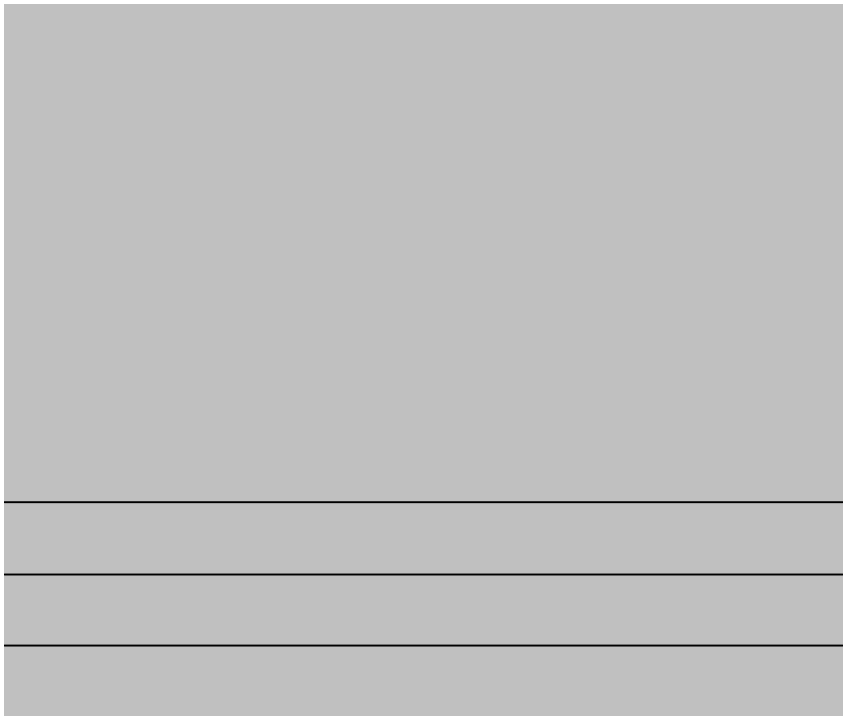
Not all data parameters available for a given test. 3Assumed average hydraulicdiameter = 2.9 mn

Del P aVd Mach Nr for Genoa Stave with C3F8 Coolant, PQn = 2.0 bar









1. Mo Hydraulic Diameters of stave and sector in series estimated as folTows for a factor of two fTow contingency (8.4 W/module), for maximum MacP number Tess tPan 0.5 and for a pressure dQfference across tPe two staves or sectors Tes tPan approximately 0.3 bar for C3F8 or 0.2 bar for C4F10.

Device	Coolant	Hydraulic Diameter
Stave	C3F8	4.5 mm
Stave	C4F10	5.8 mm
Sector	C3F8	3.3 mm
Sector	C4F10	4.3 mm

For C3F8 coolant:

Present stave exhaust tubing IDs approximately correct for factor of two
Present sector exhaust tubing IDs could be reduced by approximately 15
20%.For C4F10 coolant:

Present stave exhaust tubing IDs would need to be increased by approximately 45% for factor of two fTow contingency.

Present sector exhaust tubing IDs would need to be increased by

Inlet tubing IDs approximately correct for pressure dQfferences from Rack to start of tPe expansion